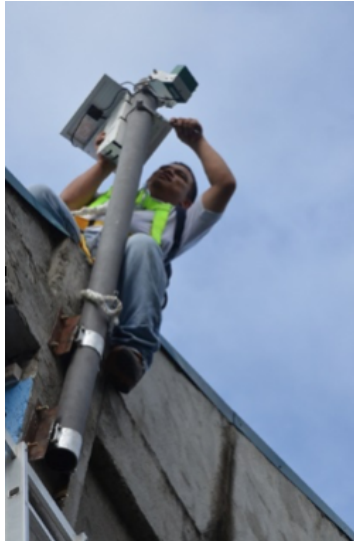


Nationwide Network of Hydrometeorological Sensors and Supporting Technologies to Gather, Process, and Deliver Data for Disaster Mitigation and Response in the Philippines



**ASEAN Next 2018: Rising STI Networking for Innovative ASEAN
Workshop on SMART Informatics for Sustainability**

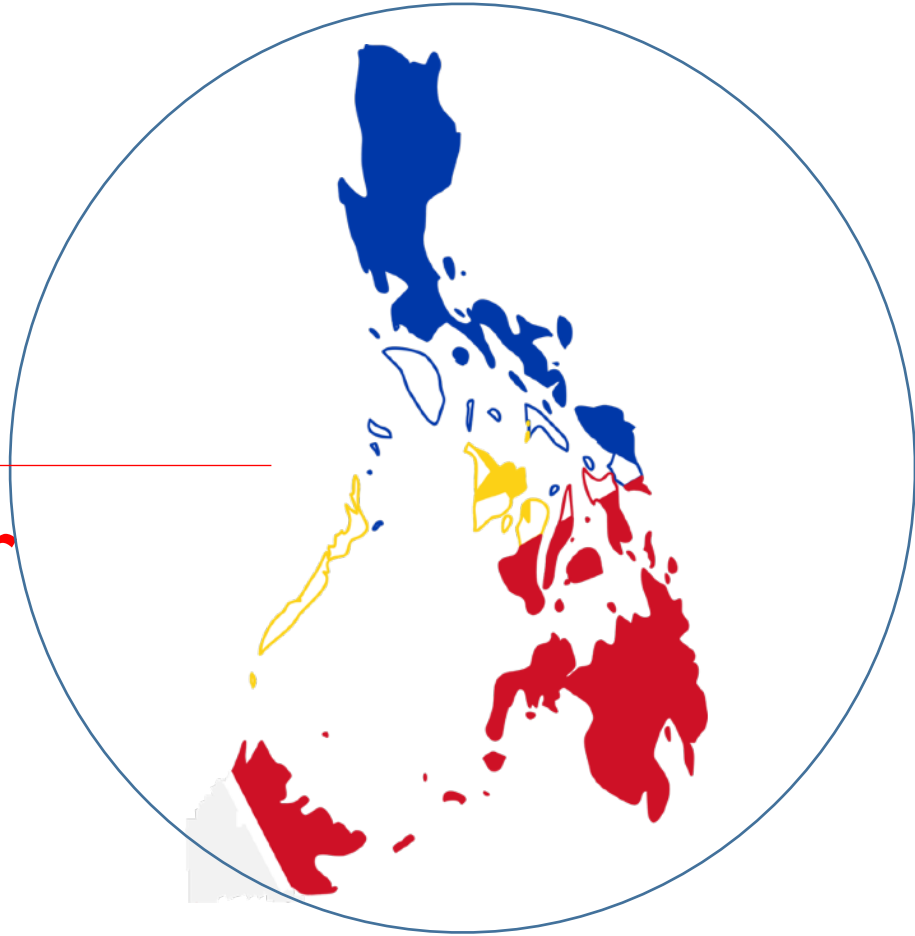
March 21, 2018

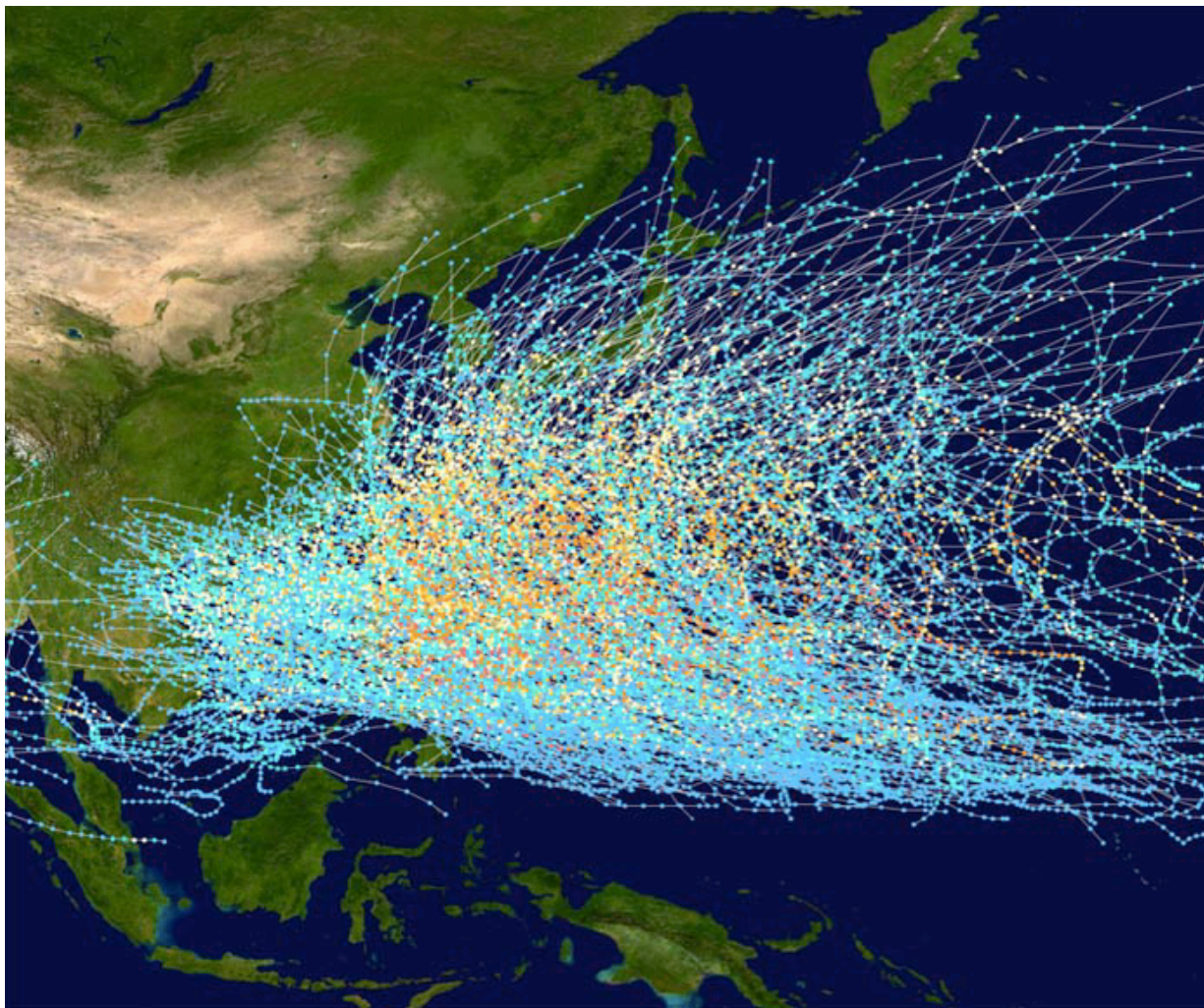
**Alvin E. Retamar, Chief Science Research Specialist
Advanced Science and Technology Institute**

DOST, Philippines

PHILIPPINES

Average:
20 Typhoons / year





Western Pacific tropical storm paths for the period of 1980-2005. As one can the Philippines is obliterated under all the lines delineating the various tracks. Only the southern portion of Mindanao Island is visible.

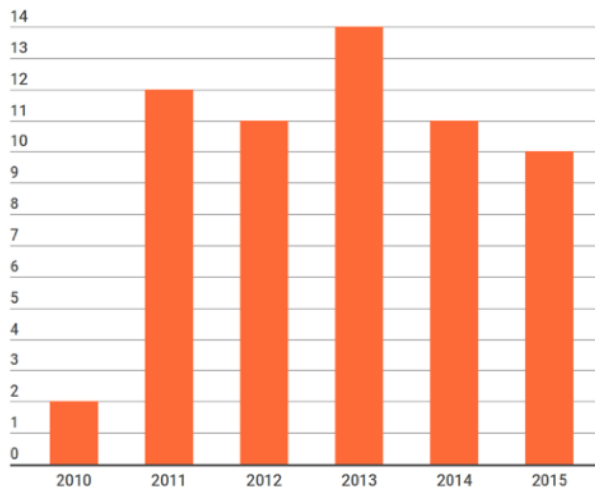
Typhoon Ketsana (2009)

- 4th worst natural disasters in the Philippines in terms of number of people affected.
- In 6 hours = 1 month rainfall
- 30% of the country were placed under a state of calamity due to severe flooding.



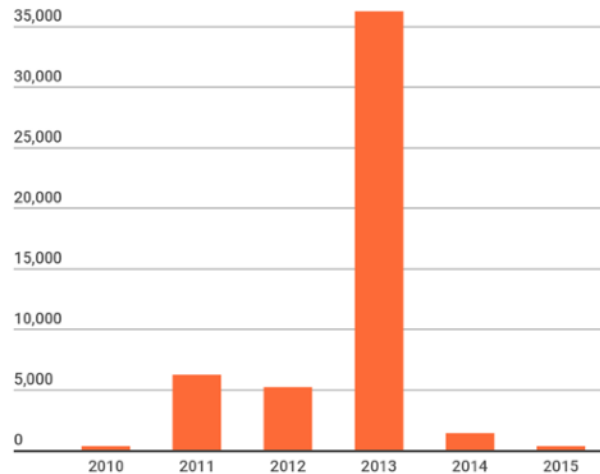
According to 2015 National Disaster Statistics...

No. of destructive tropical cyclones that entered the Philippines (2010-2015)



Source: National Disaster Risk Reduction and Management Council

Total number of casualties from tropical cyclones (2010-2015)



Source: National Disaster Risk Reduction and Management Council
Prepared by: Rappler.com



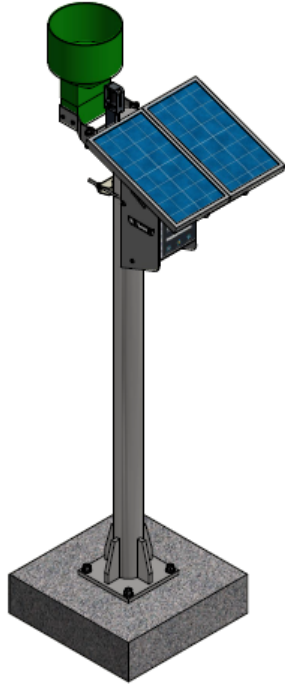
Advanced Science and Technology Institute (ASTI)

Primary Mandate: Conduct scientific research and development work in the advanced fields of Information and Communication Technology and Electronics.

- ASTI was assigned to implement a nationwide deployment of meteorological devices that can be used for mitigating weather-related disasters



Automated Rain Gauge Station (ARGS)



Measures
rainfall
parameters



Measures air
pressure



1 tip
= 0.20mm of rain



Sends data via SMS
or satellite network

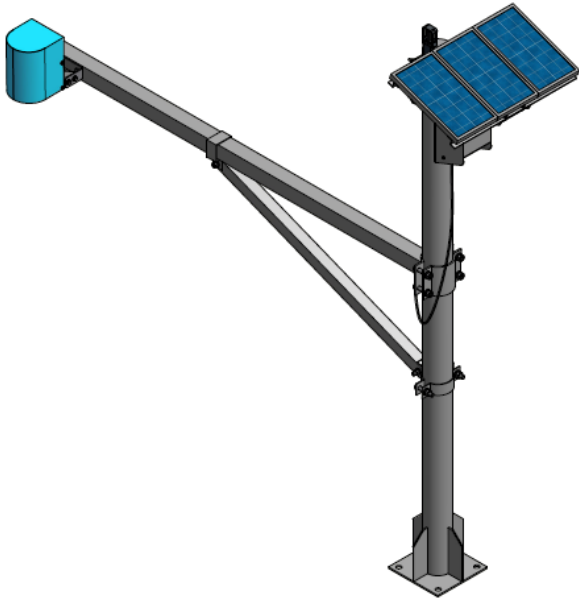


Sends data every 10
minutes



Derives power from
Solar Energy

Automated Water Level Monitoring Station (AWLMS)



Measures rate
of water



Sends data via SMS
or satellite network



Measures air
pressure

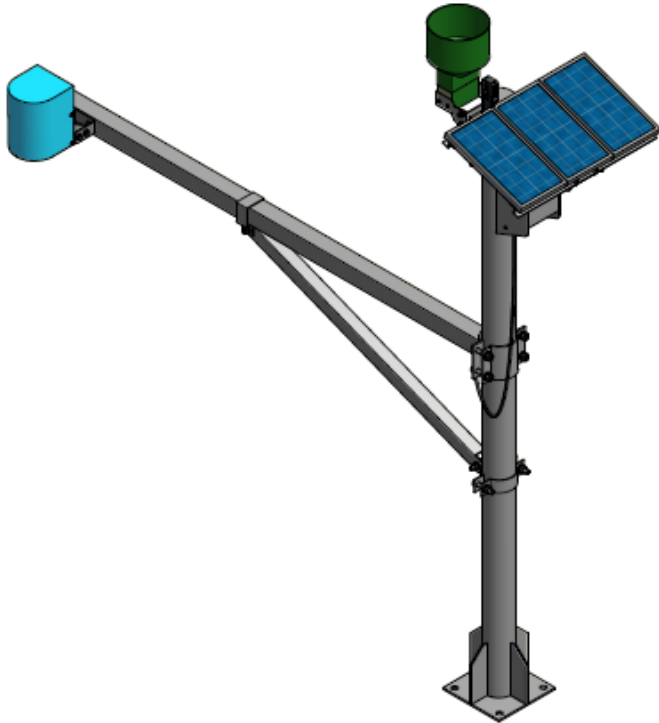


Sends data every 10
minutes



Derives power from
Solar Energy

Tandem – Water Level Monitoring Station with Rain Gauge Sensor



Measures rain amount, duration and intensity



1 tip
= 0.20mm of rain



Measures air pressure



Sends data via SMS or satellite network



Sends data every 10 minutes



Derives its power from solar energy

HydroMet Project (2012-2014)

Objective:

To enhance the forecasting accuracy of the Philippine national weather bureau.



Goal



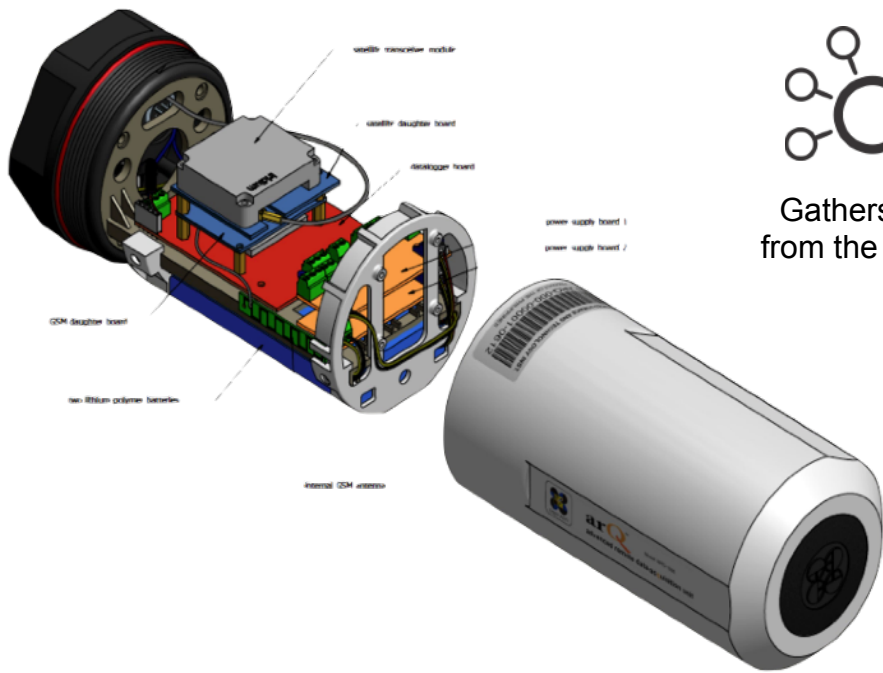
1,000

Completed



1,212

More HydroMet requests
are still coming in!



Gathers data
from the sensor



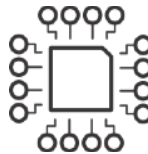
Locally developed
and produced



Sends data
through GSM and
satellite



Includes two LiPo
batteries



Supports wide range
of hardware
communication
protocol



Customizable and
flexible



Approved industrial
property model

ASTI Datalogger - Advanced Remote Data-Acquisition unit (arQ)

DEWS - Disaster Early Warning System Project (2014-2017)

01

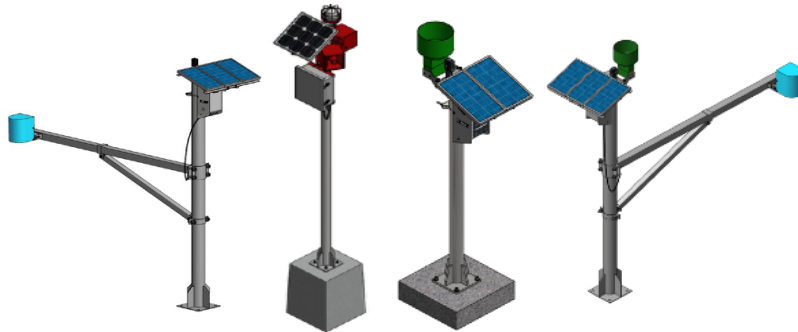
Additional **500** HydroMet devices

02

Install **500** alerting stations

03

Improved visualization website



Station Information



LOCATION
CITY CAMP LAGOON - old,
BAGUIO CITY



DISTRICT/REGION
Baguio City, Region CAR
FIRMWARE
2.5

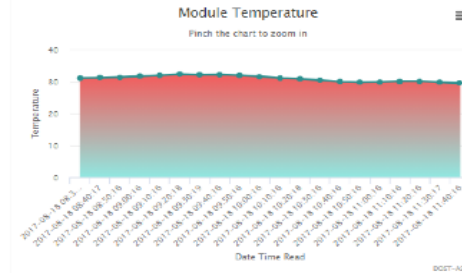


SERVER NUMBER
9473960646
SENSOR NUMBER

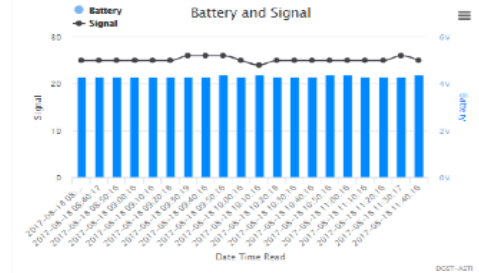


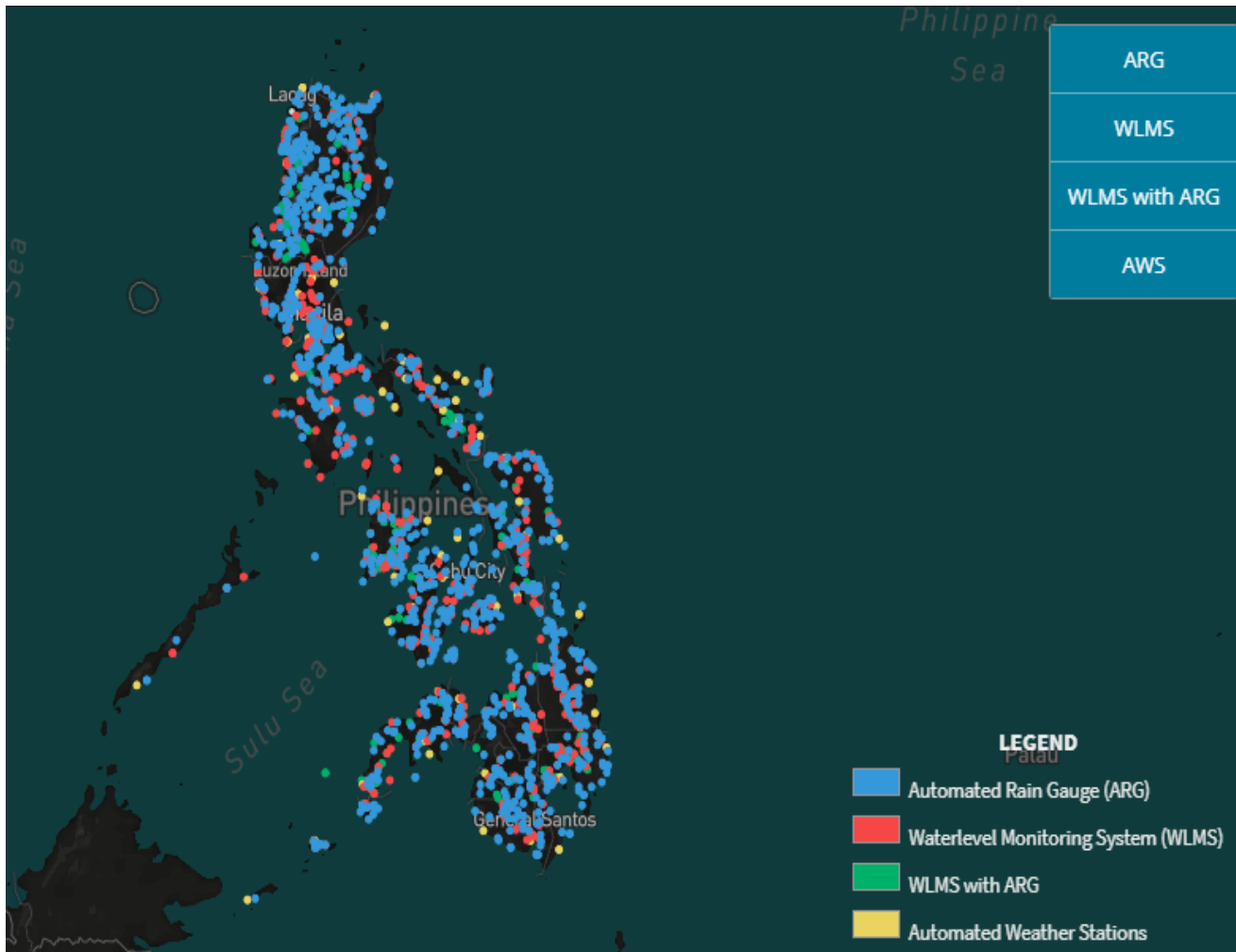
PROJECT
HYDROMET
SENSOR TYPE
Waterlevel & Rain 2

Temperature



Battery and Signal



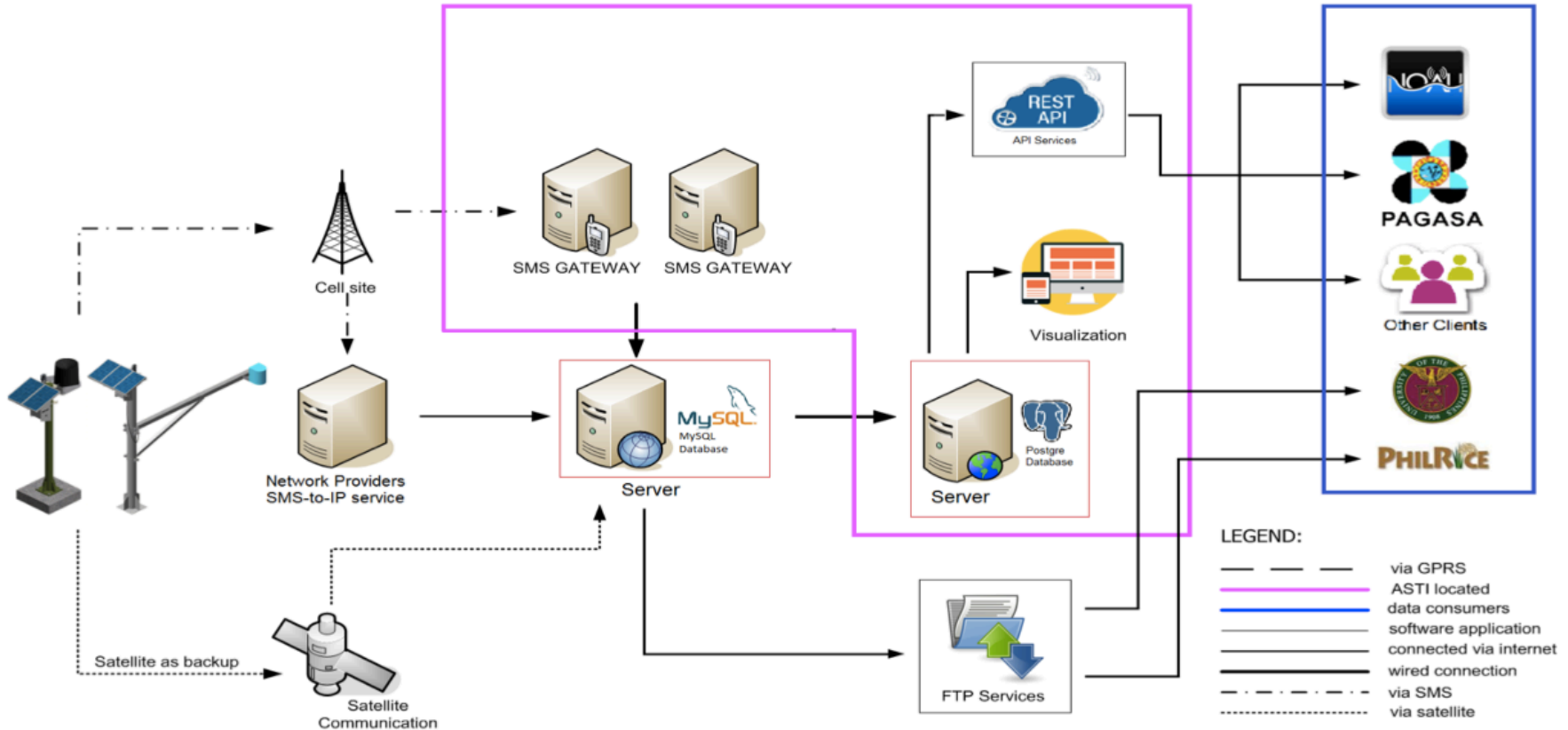


Roughly 2000 sensors deployed nationwide

Visualization (philsensors.asti.dost.gov.ph)



ASTI STATIONS NETWORK FLOW



Maintenance and Troubleshooting



ARG Antipolo, Rosario, Batangas



WLMS Macabling, Sta. Rosa City, Laguna



ARG, Old Cabalan Olongapo



TDM, Cabncalan-Canduman



WLMS, Sta. Ana Bridge, Barili



Ilaya Bridge, Dapitan City,
Zamboanga del Norte



Supon Elem. School, Bayog,
Zamboanga del Sur

Information, Education and Communication (IEC) Campaign



Presentations from Experts



Training and Workshop



Open Forum Session

IEC: Community Involvement (Flood Drill)



Challenges: Transportation and Logistics

- Deployment of HydroMets in remote and underdeveloped areas

Difficulty of transporting electronic components and other materials



Challenges: Location of Installation

- Installations of HydroMets in high risk locations

Strategic adjustments
have to be done on site



Challenges: Social and Political

- Social Issues

Threat from armed militants and insurgency groups

- Political Aspect

Installation of HydroMet Stations in areas whose leaders are members of the opposite political party



Challenges: GSM Network Availability

- Identified location is critical and important to monitor but GSM network availability is intermittent
 - *Solution is to use a satellite communication but costs more



Challenges: Theft and Vandalism

- Cases of theft and vandalism on several HydroMet stations

BEFORE



AFTER



Challenges: Theft and Vandalism

- Added security fence as countermeasure.
- Place HydroMets in government compounds and public schools

WLMS



ARG



Lessons Learned : Implementation of Security Measures

- Use of security fences and signages do not guarantee that cases of theft and vandalism will be eliminated.
- Relying on the local government units to secure the stations is ineffective:
 - *Budgetary constraints
 - *Insufficient man power

Lessons Learned : Data Reception Congestion

- GSM Congestion due to sheer volume of SMS
 - *All HydroMet stations send SMS data every 10 minutes to one location server
- Current solution:
 - *Employ additional GSM receiving gateways



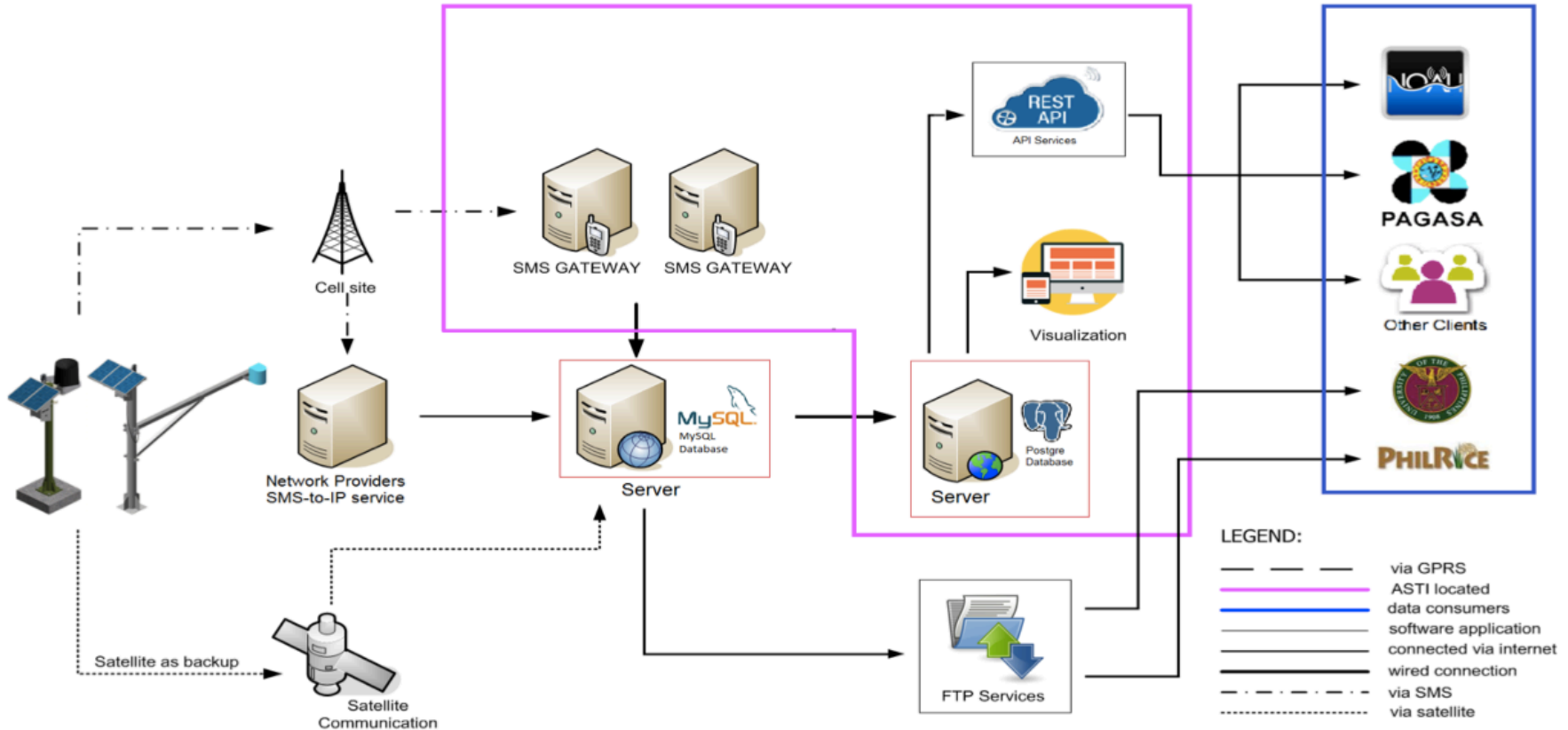
Lessons Learned : Sustainability

- Philippines have 7,107 islands, it is a challenge to manage a large scale number of stations to ensure functionality.
 - *Seek help with regional offices and provide them training for maintenance and troubleshooting.

Lessons Learned : Infestations

- It cannot be avoided that the sensors will be subjected to infestations.
 - *Bats have infested the ultrasonic sensor in AWLM stations causing erroneous data.
 - *Insects populate inside the datalogger causing eventual damage.
- Improvements on the design were implemented.
- Frequent inspection and cleaning maintenance is still the best key.

ASTI STATIONS NETWORK FLOW



Science Priorities in the Context of National Development Goals

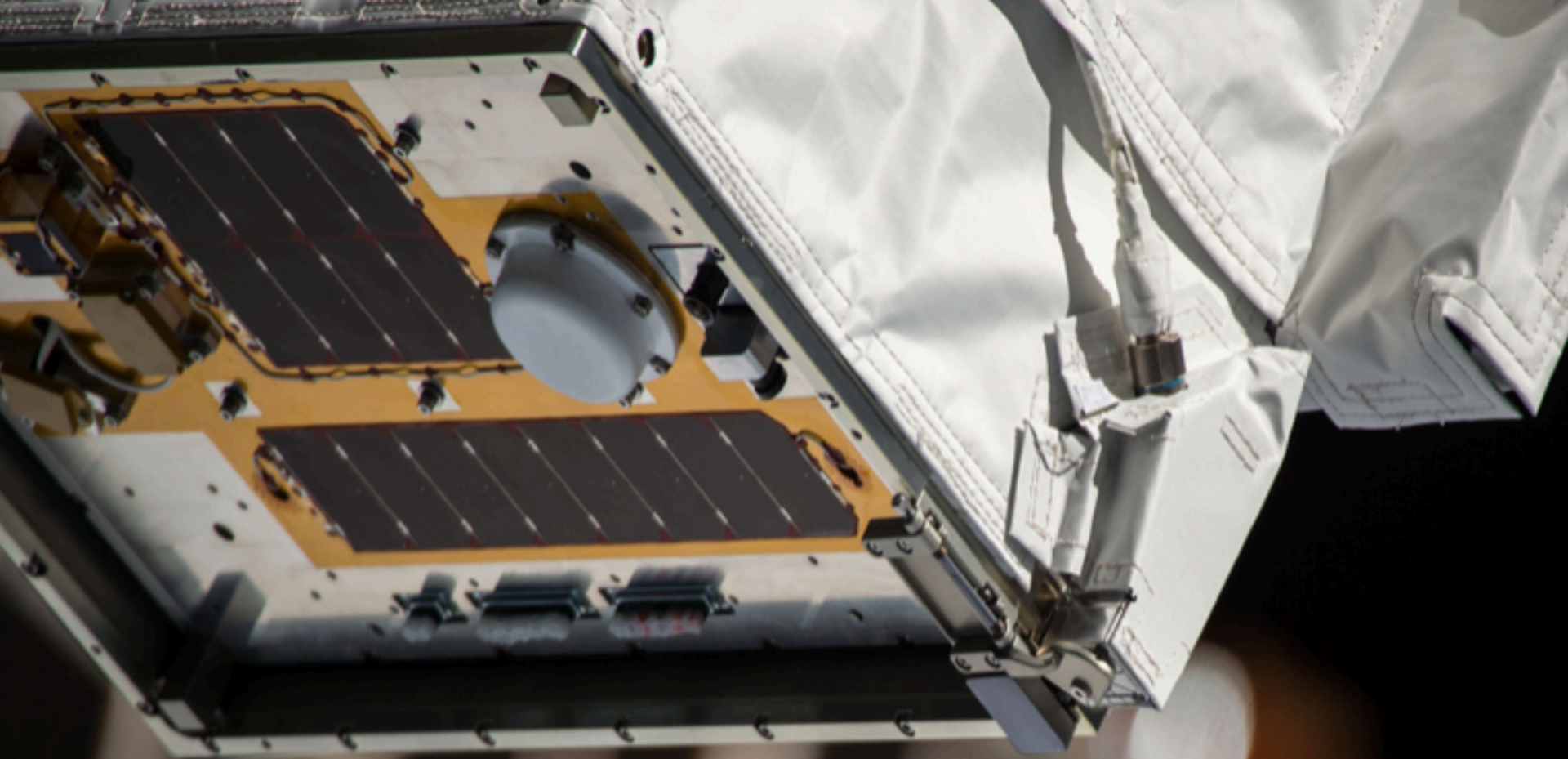
- ASTI is the primary RDI under the Department of S&T tasked to:
 - Establish and maintain science and technology infrastructure
 - Data sources: Sensors and Satellite Images/Data
 - PREGINET (National REN)
 - CoARE Facility (HPC, Storage, Cloud) for Scientific Research
 - Remote Sensing & Data Science (DATOS) Help Desk
 - Domain applications: Disaster Mitigation (Early Warning Systems: Weather Sensors Dev't & Deployment; Visualization); Advanced Network Applications; Rice Genomics; Weather Forecasting Models; Volcano Monitoring; Satellite Imaging

ASTI Hydromets/ Automated Weather Stations



DATA
DATA
DATA

images reproduced from:
<http://embedded.asti.dost.gov.ph/products/>

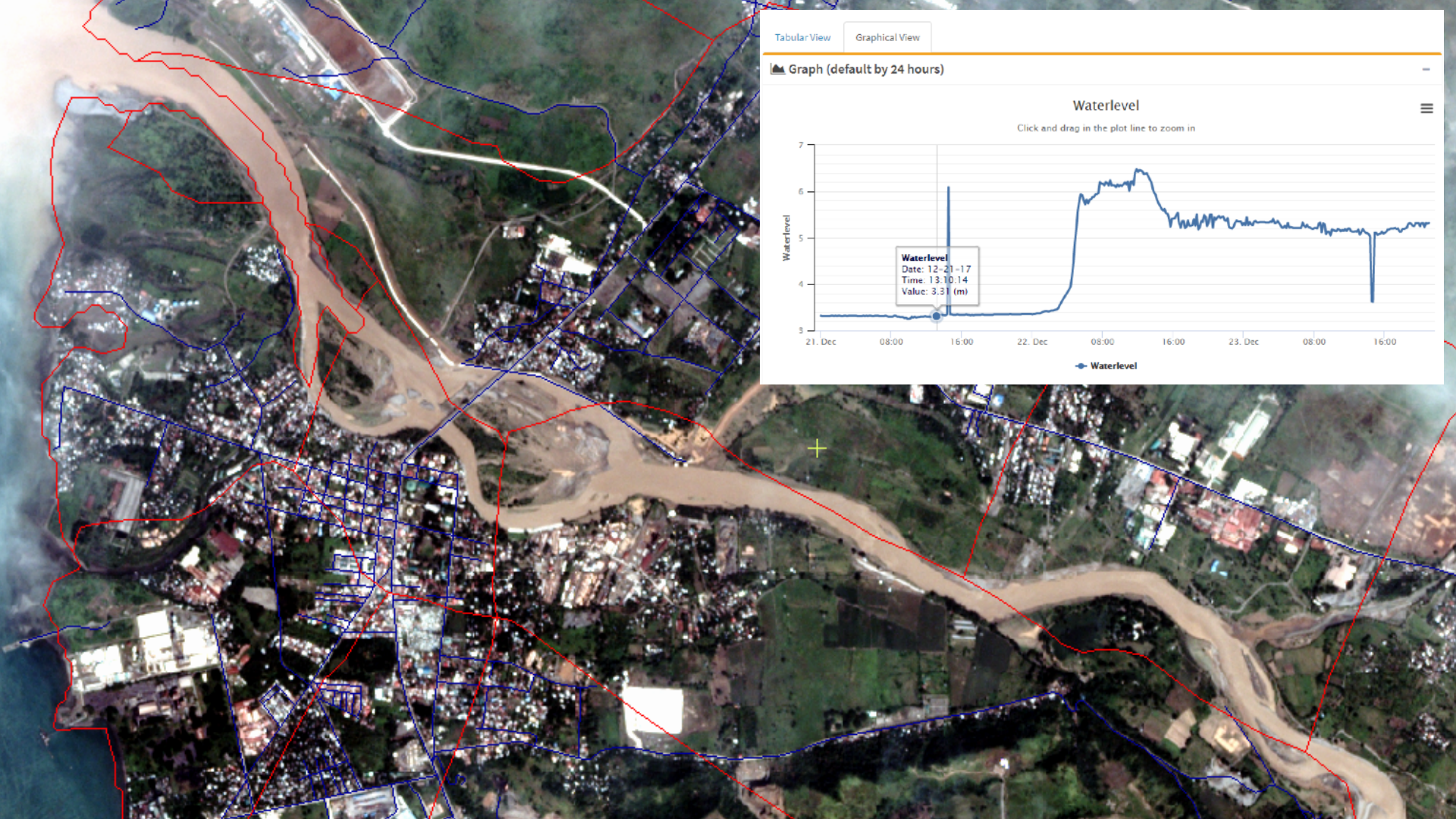


PHL-Microsatellite Program

ASTI as the de facto Ph space agency

The Philippine Earth Data Resource and Observation (**PEDRO**) Center





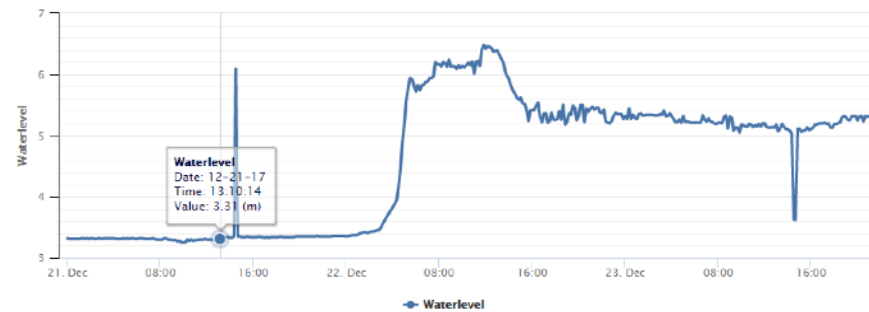
Tabular View

Graphical View

Graph (default by 24 hours)

Waterlevel

Click and drag in the plot line to zoom in





COMPUTING & ARCHIVING RESEARCH ENVIRONMENT

The CoARE was setup in response to the increasing demand for data storage and compute power. The project was conceptualized to address these three (3) user-driven needs, where our services are aligned:



STORAGE SERVICE

Repository of scientific data.
Short- to long-term data archiving support.
Storage can handle large quantity of files (GB to TB).

DATA STORAGE



SCIENCE CLOUD

Delivers cloud-based services to researchers and students.
Enables private sharing of data among specific groups.
Provisioning of Virtual Machines.

DATA DISTRIBUTION & SHARING



DATA CATALOG

Web portal for data gathered from CoARE research collaborations.
Publicly accessible data sets.
Supports open data for research and decision-support purposes.

HIGH PERFORMANCE COMPUTING



HPC

Processing of large data sets.
High-speed calculations and analysis.
3,120 cores with 10Gbps network speed.



APPLICATIONS RUNNING ON COARE:

- Flood modelling (Gerris)
- Molecular Dynamics (NAMD)
- Numerical Weather Prediction Modelling (WRF, CCAM)
- Climate Modelling (RegCM)
- Bioinformatics Pipeline (BWA, GTK)
- Storm Surge Modeling (Gaussian)

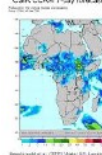
NAMD
Scalable Molecular Dynamics

Gerris

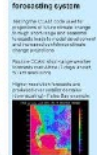


OGC
Making location count.

CSIR COAM 7-day forecast



CSIR weather forecasting system



MATLAB



DATOS

- The **Remote Sensing and Data Science (DATOS) Help Desk** aims to produce and communicate relevant disaster information to agencies and key end-users to complement the current efforts of existing government agencies and initiatives. DATOS builds on and integrates past and ongoing DOST-supported projects, as well as the use of different Geographic Information System (GIS), Remote Sensing (RS) and other Data Science techniques.



DOST-ASTI

Satellite-related initiatives

Philippine Earth
Data Resource
and
Observation
Center (PEDRO)

Development of
the Philippine
Microsatellite
Program (PHL-
Microsat)



HPC, Storage and Cloud Facility

Computing and Archiving Research
Environment (CoARE)

GIS and Remote Sensing Processing/ Products and R&D

Remote Sensing and Data Science
(DATOS) Helpdesk

PREGINET
(Distribution Network)

Stakeholders

Agencies with GIS/ RS
products requirements

PHIVOLCS
PAGASA
NAMRIA
NDRRMC
DBM

Conclusion

- Near-real time monitoring of rainfall and river water level are useful in flood prediction and modeling
- Sustainability of a large scale sensor stations is still a major challenge
- System resiliency must be implemented to ensure uptime and reliability
- Synergy among activities and projects is important to gain maximum value

Thank You for Listening!

Contact: Alvin E. Retamar (ning@asti.dost.gov.ph)

Website: www.asti.dost.gov.ph
